system of acknowledging sources of information. Another, which strikes an English reader, is the curiously unfamiliar aspect of well-known names of people and places in their Italian form—Giovanni Ross and Giuseppe Wiggins, Terra del Re Guglielmo and San Giovanni de Terranuova require some thinking over. Where so many personal names are foreign to the author, misprints may easily escape detection, and in the index a cursory inspection reveals about a dozen slips, of which the worst are Gordfelow for Goodfellow, and Newes for Newnes. Probably no English author could handle more than 600 foreign names with fewer accidents. Except for a tangle of dates on p. 98, and the necessary baldness in the treatment of some picturesque episodes induced by brevity, the narrative is clear, interesting and, so far as we can test it, correct. Most space is, of course, given to the Arctic regions; but the history of South Polar voyages is also summarised.

The members of the Italian Arctic expedition had a magnificent reception in Rome on January 14, the description of which, together with the addresses of the Duke of the Abruzzi and Captain Cagni, occupy practically the whole February number of the *Bollettino* of the Italian Geographical Society. The hall was splendidly decorated with flags and Arctic trophies; and the King and Queen of Italy, with other members of the Royal family, the great officers of State and the Diplomatic Corps, as well as the heads of the scientific bodies in Rome, were present.

The Duke of the Abruzzi described the equipment of the expedition and the voyage of the famous whaler *Jason*, renamed the *Stella Polare*, to her winter quarters in Teplitz Bay; and after Captain Cagni had told the story of his great sledge journey over the ice, H.R.H. resumed the narrative of his sojourn at the base and the return of the party to Europe.

The following is a brief summary of the facts:—

The *Stella Polare* left Archangel, where she had called for dogs, on July 12, 1899, and, after some delay in the ice, passed Cape Flora, in Franz Josef Land, on the 26th, sailed up the strait named by Jackson the British Channel and along the shore of the Queen Victoria Sea to a point in 82° 4′, just north of Cape Fligely on Prince Rudolf Island, which was reached on August 8th, after a good deal of trouble from the ice. Teplitz Bay, in 81° 47′, was chosen for wintering the ship; the dogs and stores were landed there, and the ship, having been damaged on September 9 by an ice-pressure, the party was obliged to land and live on shore. During the winter the Duke of the Abruzzi was severely frost-bitten in the hand and was obliged to abandon his intention of accompanying the sledge expedition to the north in spring. The command of this expedition accordingly devolved on Captain Cagni. The sledges used were of Nansen's pattern; the sleeping bags for the men were made of reindeer skin; pemmican was the chief food relied on, and petroleum was used for cooking. The expedition was marshalled in three divisions, each consisting of three men and four sledges, on which were placed 180 rations for men and 1150 for dogs. The provisions of the first division would suffice for the whole party for fifteen days after leaving the island, when the people of that division would return. The provisions of the second division would supply the two remaining groups for fifteen days more and then suffice to allow its members to return to the base, while the third group with their intact store of provisions should be able to push on for fifteen days more, or forty-five days from the base, before requiring to return.

In some preliminary sledge trips in February a temperature descending to −52° C. (−62° F.) was recorded, this being the lower limit of the graduation of the minimum thermometer. The start for the real attempt on the pole was made on March 11, 1900, when the caravan of three parties struck out boldly across the sea-ice, bound north, Captain Evenson and two sailors accompanying the expedition for two days with a thirteenth sledge. The advance at first was slow, on account of bad weather and rough ice. On March 22 the first division, consisting of Lieut. Quirini, the guide Ollier, and the engineer Stökken, left to return to Teplitz Bay. This party has never since been heard of, and there is little doubt that all three have perished. On March 31 the second group went back, and Captain Cagni continued on his way with three companions, Italian Alpine guides named Petigax, Fenouillet and Canepa. By sending back the other parties some days earlier than was at first intended he was able to retain a larger supply of provisions. Six sledges were taken on, and in spite of the difficulties of the way the party made excellent progress, and by reducing the rations they were able to continue the northward march to 86° 33′ 49″ in 64° 30′ E., which was attained on April 25. The journey at times was comparatively easy, the ice in places being smooth and covered with firm snow, but frequent pressure-ridges had to be surmounted and proved serious obstacles. In the latter part of the journey, when the temperature did not descend below zero Fahrenheit, lanes of water often opened with dangerous suddenness and caused great delay, while frequent gales and bad weather of every kind were encountered. The return journey, with rapidly dwindling provisions and diminished strength, was extremely laborious and the steady drift of the ice to the westward was a very serious difficulty, and, despite an increasing easterly component in the direction of march, the first land sighted was Harley and Neale Islands and Cape Mill, fifty miles west by south of Teplitz Bay. It was June 22 before the base was reached, and Captain Cagni had been absent 104 days, making (apart from the loss of the three men in the missing party) perhaps the most successful sledge journey ever accomplished in the Arctic regions, and certainly reaching the highest latitude.

The *Stella Polare*, after temporary repairs, was released from the ice with great difficulty, and only succeeded in getting away from Teplitz Bay on August 15, after which a good passage was made to Norway.

The results of the expedition are touched on slightly. Petermann Land and King Oscar Land, reported by Payer, have been shown not to exist in sight of the positions assigned to them. Cape Fligely (81° 51′) is proved to be the most northerly point of Franz Josef Land, and Cape Sherard Osborn does not belong to the same island, if it has any real existence. Doubt is thrown on the existence of the islands reported by Wellman north of Hvidtenland; but the maps of the Jackson expedition appear to have been found accurate so far as they could be tested. A year's meteorological and magnetic observations were obtained at Teplitz Bay, and gravity and tidal observations were also carried out. Prince Rudolf Island was found to consist entirely of basaltic rock. Animal life was not found very abundant, polar bears being the only common land mammals, and no new birds appear to have been discovered.

HAILSTORM ARTILLERY.

IN the absence of any recognised English equivalent for the expressive German term *Das Wetterschiessen*, I have thought it best in the heading of this article to avoid a literal translation of it lest it should give rise to misunderstanding. "Weather shooting" does not refer to any haphazard or empirical attempts to foretell the weather, but to a practice which has lately come to have great vogue in Styria, Italy and elsewhere of firing off charges of gunpowder to protect the vineyards against injury from hail. So popular indeed has the practice become in some districts that there is danger of the cost of the protection exceeding that of any damage likely to be caused by the hail.

The idea that the weather can be affected by the discharge of gunpowder is not a new one. There have been various traditions of rain falling after, and presumably in consequence of, the cannonade of a battle, and I have some recollection of an account in English newspapers of an American enterprise for terminating a drought by a sufficiency of gunpowder.

Weather shooting as now practised has, however, a more definite purpose than merely causing rain. Its object is to prevent the downpour of hail by shooting when thunder or hail clouds threaten. Even this form of the application of gunpowder to the management of the weather is by no means new. The *Meteorologische Zeitschrift* of March 1900 states, on the authority of Arago, that in the seventeenth century a fleet, anchored off Cartagena (South America), dispersed a daily afternoon thunderstorm by a daily bombardment; and Leonardo da Vinci is said to have asserted that damage by hail could be averted by mounting mortars on the hills from which the storm-clouds came and shooting at them. Quite early in the past century the matter was taken up in the neighbourhood of Macon. The recent development, which has spread very widely, is most conspicuously represented by the arrangements of Bürgermeister Stiger, of Windisch-Feistritz, in Styria, where they were originally introduced in 1896 in the form of a vine-dressers' volunteer artillery. Batteries of ten heavy mortars to take a charge of 120 grammes of powder, served by six men each, were placed at twelve separate stations within two square kilometres at a high level near Windisch-Feistritz. As soon as a downpour of hail threatened, the 120 mortars were fired "incessantly" until the danger was past. The second year thirty-three stations were at work, and the third fifty-six. It is reported that this energetic proceeding has completely protected the region from hail and has mitigated the damage from lightning; and as Bürgermeister Stiger apparently introduced the system as an alternative to covering the district with wire of close mesh, the damage must have been previously regarded as a serious matter. Other places have been less successful, and the Austrian Government and local authorities have taken steps to inquire into the effectiveness of the shooting. But the vineyard districts are not willing to wait for the report of the inquiry; they are satisfied that they only failed because they did not shoot early enough or often enough, and only desire to shoot more and oftener.

It is not quite clear how the effects of the shooting are manifested. In some cases it would appear that the shooting dispersed the clouds altogether, in others that it caused rain, sometimes heavy rain, sometimes a genial and welcome rainfall instead of the malignant pelt of the hail.

Dr. Pernter, of the Austrian Meteorological Department, was of the commission appointed to inquire into the matter, and in the September number of the *Meteorologische Zeitschrift* he gives a most interesting account of some experiments in connection with the inquiry. From that account it appears that there are three forms of apparatus employed, differing in size. A small cylindrical mortar with a large conical mouthpiece is the general form of the apparatus.

The conical portion of the smallest system (System Unger) is 2 metres long, that of the longest (System Suschnig) is 4 metres long; the former takes a charge of powder up to about 60 grammes, the latter up to about 250 grammes. Briefly, the latter is the most effective implement, and a charge of 180 grammes is the best suited for the purpose.

The effect of the shot is to produce, besides noise, a vortex ring of most impressive dimensions and energy. It would start with a loud hum and settle down to a whistle. When the gunpowder charge was most suitable, it would tear a thick paper screen to pieces at 100 metres distance from the mortar and pull the wooden framework of the screen apart and hurl the pieces about. Dr. Pernter, indeed, becomes quite eloquent in his description of the behaviour of these rings as astonishing physical experiments quite apart from any practical interest they may have as affecting the weather.

The position of the ring is recognisable by its whistle after it has become invisible, and its duration is estimated by the duration of the whistling. In the firing the rings are shot upwards, and it is assumed that the effect of the shooting depends upon them.

Dr. Pernter's experiments were directed mainly towards ascertaining the velocity and the length of the path of the rings, with the ultimate object of determining whether they could reach the levels of the lowest stratum of rain cloud. Determining the velocities from a very large number of experiments with charges of different weight, he obtained in the most favourable circumstances with the Suschnig apparatus an initial velocity of about 55 metres a second and a height of 400 metres as the extreme probable limit of the best shots. Thus the experiments seem to show that the rings would not reach the storm-clouds at the 1000-metre level, but as the local people were convinced from their own observations that the storm-clouds in the neighbourhood of St. Katherein (where the experiments took place) were to be found at 800 metres, and as the shooting-gear was fixed at elevations of some 500 metres, it seemed possible that the rings might just reach the clouds.

Such is the result of the investigation, with the addition that the smaller apparatus would not carry nearly so far, nor would the rings have anything like so much energy as those from the larger apparatus, whence it follows that if we wish to shoot the clouds effectively we must use the largest-sized mortars, taking 180 grammes of powder, and we should then be a little uncertain whether the ring would travel far enough.

Various theories have, of course, been suggested to account for the protection from hail alleged to be secured by this shooting. Supersaturated air from which the rain is liberated, a labile state of atmospheric equilibrium disturbed by the discharge, globules of overcooled water, still liquid below the freezing-point, which would form large hail-drops if they were allowed to coalesce but are solidified separately by the shock, and many other suggestions have been put forward as the state of things precedent to the hail shower, which is disarranged by the shooting. There seems, indeed, to be a disposition to see what curious conditions our present knowledge of the physics of the atmosphere can account for, and then wonder whether one of them might be the condition of things in a thunder cloud. Theory is very much at a disadvantage, because it is not at all clear what has to be explained, and it is, indeed, difficult to account for facts when we do not know what are the facts to be accounted for.

Dr. Hann has suggested, very properly, that the effect of shooting upon a winter fog should be ascertained. There appears to be some evidence that gun-firing clears the air of such a fog. But whether theory is to regard the noise or the smoke or the energy of the vortex ring as the cause of the effect, or whether, indeed, there is any effect to be explained, is not yet finally established. At the same time, no one is prepared to say that no effect is possible or is willing to lay claim to sufficient knowledge of the conditions of the atmosphere immediately preceding a hailstorm to venture any categorical opinion on the various theories. The subject was brought before the conference of meteorologists last year at Paris by several writers, and some additional information about it will doubtless appear in the report of that conference when it is published; in the meantime, the prominent meteorologists of the countries where there is a great popular demand for weather shooting, Styria, Hungary, Italy, Switzerland and France, are unanimous in the desire that the demand may lead to definite investigation of the nature of the processes taking place in thunderstorms, and especially in the formation of hail, which will lead to a real advance in our knowledge of these phenomena and will furnish a satisfactory basis for a theory of weather shooting. W. N. SHAW.

VIRIAMU JONES.

YET another gap in the front rank of science. But yesterday it was Fitzgerald, then Rowland, and now—Viriamu Jones is dead, the last, like the first, especially great in inspiring others.

Son of a working collier, a collier with rare gifts, the "poet-preacher" of Wales who thrilled with his silver tongue the gathered thousands and moved the multitude with his mighty eloquence, Viriamu inherited all those qualities which tend to greatness and came into daily contact with them in his own home. His very name indicated what was expected of him, for "Viriamu" was the name of the martyr missionary Williams, rendered as best it could be by the Polynesian tongue.

At the earliest permissible age of sixteen, Jones passed the London matriculation examination and won the scholarship in geology, the subject in which he took his degree with first-class honours three years later. Meanwhile he was gaining prizes, medals and scholarships at University College, London, and was elected Brackenbury scholar at Balliol College, Oxford. Going there at the age of twenty, he came under the direct influence of Jowett and commenced that personal friendship which influenced his whole life. After obtaining a first class in mathematical moderations in the final school of mathematics and in the final natural science school, he was elected principal and professor of mathematics and physics in the Firth College, Sheffield, when only twenty-five.

How he used to laugh because he always knew exactly what an examiner wanted; and what a true estimate did he form of the poverty of the examination system to test a man's real powers. How sympathetic was he when one was despondent at the unpractical character of the "intellectual miser," the student who spends his time acquiring and hoarding knowledge without giving the world a single new idea of his own. His views on education were of the broadest; to him the study of Greek and Latin, a problem in mathematics, the adjustment of a Whitworth measuring machine, were all equally living, and in the niceties of all three he showed the same absorbing interest.

No wonder, then, that when the first principal of the University College of South Wales had to be appointed the council chose the youngest of the thirty applicants —for that youngest was Jones in his twenty-seventh year. And no appointment ever made was better justified. The many speeches to his memory, the letters that have flowed in from every side, including one from the King, all prove how the work of the principal was appreciated, how the man was idolised.

He placed the University College system of Wales on a truly educational and democratic basis, and shaped the educational policy of his country by formulating the system of secondary education, which fills the gap between the primary schools and the colleges, and by the part he played in establishing a University for Wales.

The charm of his personality, his magic smile, the grace of his diction and his winning persuasiveness secured success where others could but court failure. Some 70,000*l*. he gathered together for the building of the new college, but a free site was still wanting, for this had been refused by the Corporation last summer, when Jones was too ill to be in England. Returning, however, in the autumn, he sought an interview, as a belated member of the deputation, charmed the Corporation into reversing their decision, and won for his college a site as a free gift. Well might Sir William Harcourt, when Chancellor of the Exchequer, jocularly say that Principal Jones was the cleverest beggar he had ever met with, and about the only one he could not get rid of without promising to give what was asked for.

Deep is the gratitude the college feels for its first principal; sincere is the praise Wales is reverently showering on the young first Vice-Chancellor of its University.

During the last few years I saw much of Viriamu Jones in connection with the construction of electrical standards, and I was always struck with surprise at the way in which one who found his greatest relaxation in studying the poetry of the most regular and attentive of his father's congregation—Robert Browning —discussed in detail why he thought the physical theories of the day too fanciful, and criticised the modern electrical measuring instruments for not being constructed on engineering lines.

His immediate ambition was to provide the National Physical Laboratory with electrical standards constructed like well-designed engineering machine tools rather than the ordinary physical laboratory apparatus, and it was towards such an end that his scientific work of recent years tended. A certain City company had promised him the funds for a far more perfect Lorenz apparatus than any yet made, and many were our talks about its details, how the coil and rotating disc were to be horizontal, and the non-magnetic driver a turbine, &c.

His first paper on this particular subject of electrical standards was published in 1888, and consisted of a determination of the coefficient of mutual induction of a circle and coaxial helix in connection with constructing the coil of a Lorenz apparatus by winding a *single* layer of wire in a screw thread cut on the surface of a large brass cylinder. For it seemed probable that with such a coil Lord Rayleigh's formula, which is a first approximation, would not give a result of sufficient accuracy, and Jones succeeded by a method of direct integration in obtaining a comparatively simple formula which gave the coefficient of mutual induction with greater accuracy, and enabled a single larger coil, the geometry of which can be better known than one of many convolutions, to be employed. In the following year he discussed the employment of Lissajous' figures for determining the rate of rotation of the disc of the Lorenz apparatus and of a Morse receiver for measuring the periodic time of the tuning-fork employed.

In 1890 he announced, at the meeting of the British Association at Leeds, that with the use of his specially constructed Lorenz apparatus the ohm was equal to the resistance of 106·307 centimetres of mercury one square millimetre in cross-section at 0° C., the complete account of the apparatus, its use, the mathematical calculations employed and the results obtained being published in the *Philosophical Transactions* of the Royal Society for 1891. Three years later he was elected a Fellow of that Society.

Appendix iii. of the 1893 Report of the British Association Committee on electrical standards consists of the results of his use of the Lorenz apparatus to measure directly the value of commercial low resistances of the order of 1/5000th of an ohm with an accuracy of one part in 12,000, as contrasted with the comparison of such resistances with a known standard in the ordinary ways. Appendix ii. of the 1894 Report deals with a determination of the ohm by measuring the absolute value of the resistances of a combination of four coils which had been compared with the standards of resistance in the Cavendish Laboratory; while in Appendix ii.